From: Lizdoer@aol.com [mailto:Lizdoer@aol.com]
Sent: Friday, September 22, 2006 8:20 PM
To: Svetich, Ralph
Subject: Comments on DRMS effort

Dear Mr. Svetich,

I would like to point out one major shortcoming in the methodologies outlined in the ITFs that needs to be addressed, namely the implementation of new technology.

The recent advances in sensor technology, coupled with advanced software make it possible to obtain complete "3-D" images of levee structure, both above and below water. Additional insitu sensors can remotely monitor these dynamic structures and track their behavior as they transition from fully saturated to dry season conditions.

The "over arching" GIS system under development by DOER in collaboration with ESRI can utilize historical data, such as that provided by PBS&J, while incorporating new data sets yielding a comprehensive "big picture" map. An integrated GIS system will have value to multiple stakeholders, from DWR to scientists, to policy makers. It will also facilitate detection of areas with similar construction in the event of a failure, auto flagging to help direct responders in an emergency.

I have attached a PDF file describing the TULES system developed by DOER Marine along with a memo produced by the Bay Area Council, calling for the use of new technology.

One additional area where TULES could prove valuable is an area omitted in the DRMS effort, that being protection of the Delta from a homeland security aspect. Potable water is expected to become more valuable than oil, and in some regions it already is. Deliberate strategic breeching of our levees could wreak similar economic and environmental damage, comparable to a major temblor on the Hayward Fault.

In meetings with different agencies in the State and with the State Geologist, the cost of implementing TULES has been described as "budget dust". It is our hope that the Department of Water Resources will recognize the value of what new technology such as TULES has to offer and include it in every aspect of the initial technical framework.

With very best regards,

Liz Taylor
President
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tules TERRESTRIAL & UNDERWATER LEVEE EVALUATION SYSTEM

BACKGROUND

DOER Marine is a robotics engineering firm located in the San Francisco Bay Area, providing specialized solutions for challenging underwater and harsh environment tasks. The basic premise behind the DOER approach to solving these problems is to select the best technology and complementary technologies to accomplish the goals – be they for scientific, engineering, or commercial applications.

Over the past 5 years, awareness about civil infrastructure has increased. Examples of these include underground tunnels, pipelines, aqueducts, dams, bridges, and levees. These are structures that one rarely considers until they fail with devastating results. DOER has worked steadily to adapt both land and ocean sensor technologies for new applications including confined spaces and shallow turbid water.

DOER has completed many challenging tunnel and pipeline inspections, some in excess of 8 miles with real time data, video, gas monitoring, and communications. Utilizing the internet, engineers observe, comment, and recommend from offices without ever traveling to the site. Remotely Operated Vehicles have been used with similar effect in water filled tunnels around the word. Data collected yields valuable information about condition, faults, and expected lifespan.

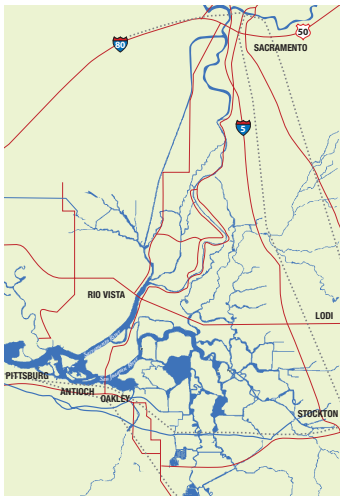
Levees and earthen dams present special problems. Turbid muddy waters, vegetation, mixed or unknown construction, poor access, and environmental concerns have made them difficult to proactively monitor and repair with assurance. In most cases, levee repair means dumping more rock or sandbagging along the top while inspection means drilling cores and noting visual damage. DOER has developed a suite of sensors and vehicle delivery systems that complement and enhance traditional levee inspection protocols. This group is collectively called **TULES**, Terrestrial & Underwater Levee Evaluation Systems.

Utilizing cutting edge technology, the engineering and technical staff at DOER combines sensor technology along with electronic media and integrated software. These components are then incorporated into application specific vehicle platforms capable of accomplishing both internal and external inspection and investigations, yielding in situ data and images. These data sets are then analyzed and post processed into interpretable results that are geo-referenced for future inspection and ongoing monitoring.

By building the data into a Geographical Information System (GIS), engineers, scientists, and policy makers can be provided with the most comprehensive and up-to-date data sets permitting informed decision making and effective resource allocation. Over time, both historical data and visual inspection data can be incorporated, resulting in a fully classified inventory.

RATIONALE BEHIND TULES

As technology has advanced we have seen profound changes in the way we live our lives. Cell phones have changed the way we communicate, the Internet has changed the way we disseminate information, and Magnetic Resonance Imaging (MRI) has changed the way medical testing is done. Our society has embraced preventive diagnosis and non invasive testing for the health of our bodies. A number of these same principals can be applied to the infrastructure we depend upon everyday, identifying decay, averting sudden failure, and targeting repair.



The Sacramento San Joaquin Delta

Armed with facts, engineers, scientists, and policy makers can make informed decisions.

Aging levee systems and dams are all that protect many cities and the vital infrastructure that businesses and homeowners depend upon. All of the experts agree on one thing: these structures will fail given a good nudge. In New Orleans, the oft-predicted “perfect storm” arrived. In California, “the Big One” too will arrive in due course, but without the luxury of a reliable forecasting system. While we cannot predict exactly when and where a major seismic event will occur, we can diagnose the health of a structure. This information can help engineers to predict the ability of a given structure to resist a temblor or other natural forces.

PROJECT TEAM

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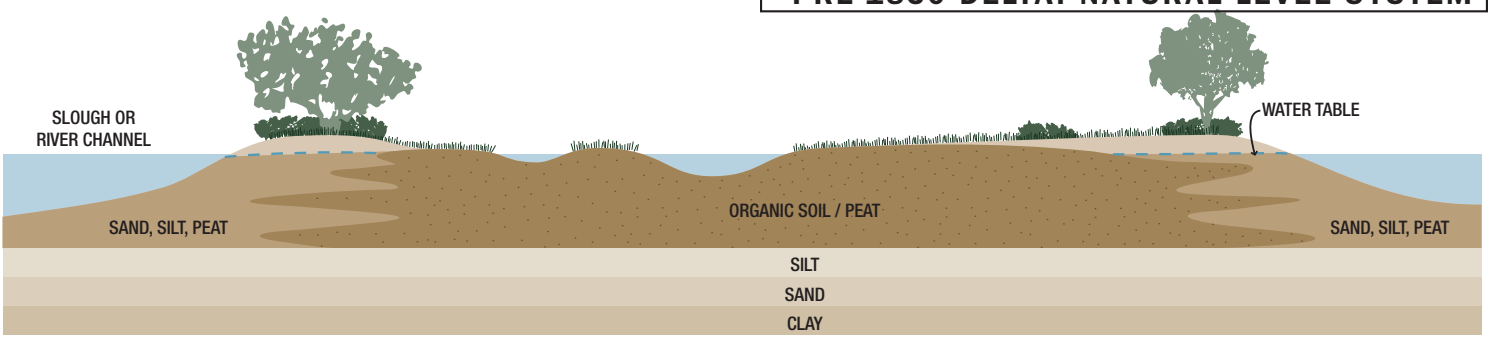
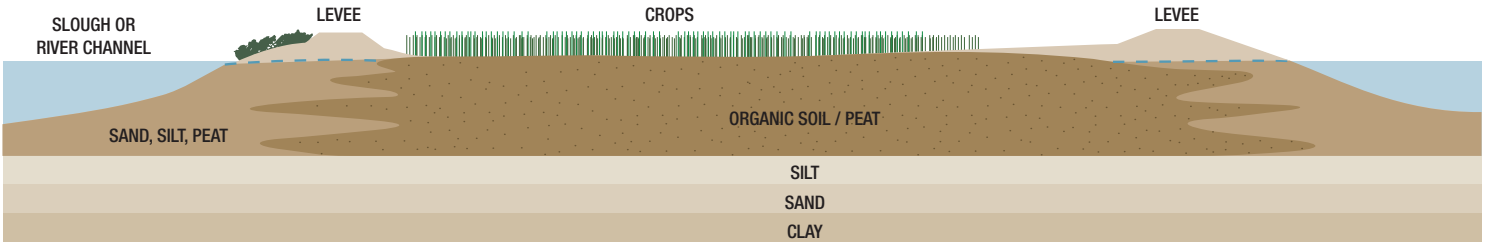
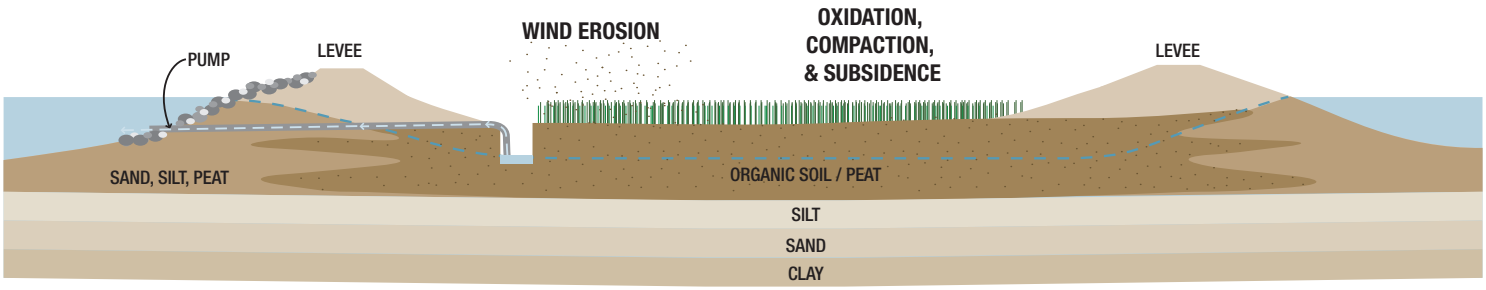
PRE-1850 DELTA: NATURAL LEVEE SYSTEM



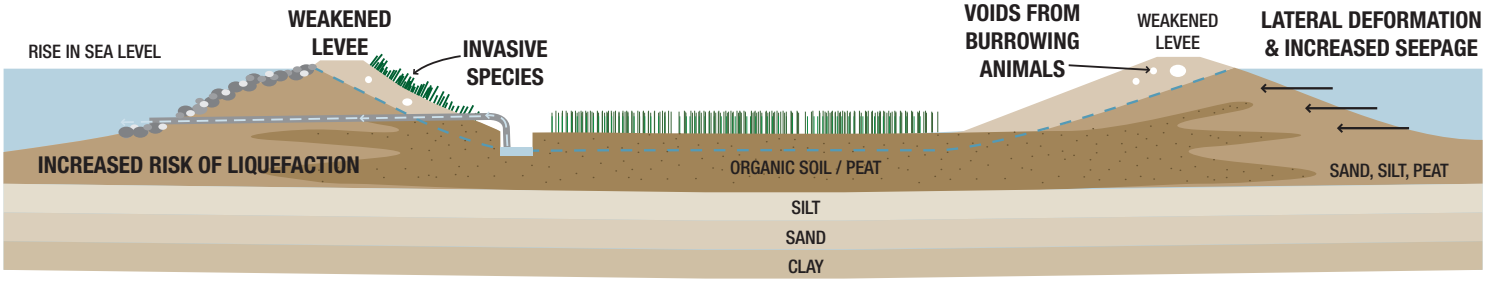
1870s: INITIAL LEVEE CONSTRUCTION



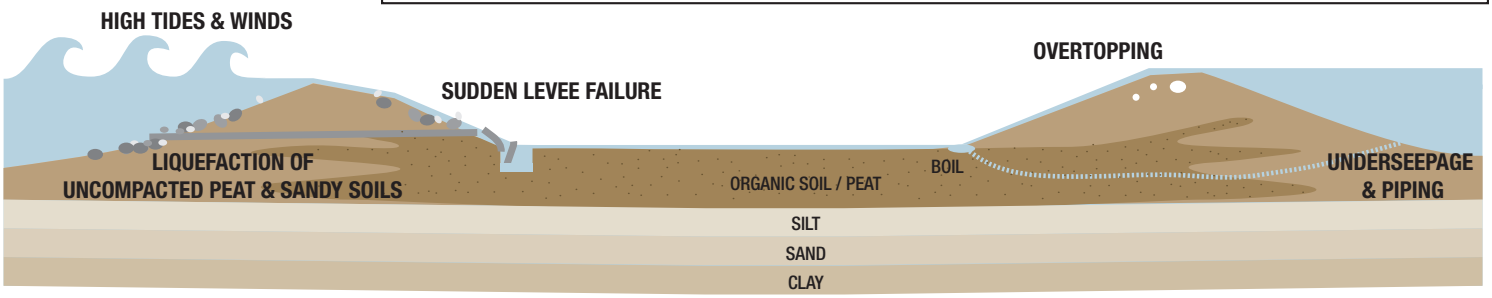
1900s: ISLAND SUBSIDENCE



1900s - 2000s: DECREASED STABILITY



PRESENT: CRITICAL WATER SUPPLIES & STATE ECONOMY AT RISK



Graphics and Layout by Sasaki Associates

Armed with science rather than conjecture, engineers can plan and allocate our limited resources for repair, reinforcement and, in some cases, removal and wetland restoration. The combined sensor technologies that are the heart of TULES provide the multifaceted "whole body" view that some have begun to call, "an MRI for the levees."

"An MRI for the levees."

WHY THIS HAS NOT BEEN DONE BEFORE

Historically, inspections have been conducted by visual observation, noting external surface defects. Destructive testing methods including coring, which provides limited amounts of data from the internal part of a levee, were combined with visual data. This allowed engineers to extrapolate and form best assumptions. This historical data is difficult to access and subject to misinterpretation. Coring, while a valuable tool, is destructive not only to the structure itself, but also to the surrounding environment due to the size and weight of the drilling equipment.

In just the past few years, new technology for securing our borders and harbors has evolved from sensors originally developed for physical oceanography and gas/oil/mineral exploration. Through integrated software and hardware development, these sensors can be applied in ways that were not possible even a year ago. The flexible architecture of TULES can adapt to these changes and is designed to grow and evolve with technology, resulting in sound data and science. From this data, along with visual inspections and targeted "ground truth coring," engineers can form a comprehensive remediation plan – one that could not be achieved in past.

Geographical Information Systems (GIS) have started to provide an electronic method of storing and accessing data for comparative analysis of the structures. This has been the first step in applying technology, yet much remains to be done in terms of incorporating current and historical data into a useable, comprehensive system. In past, experiments with GIS have sometimes become splintered depending upon which agency is providing the new data and where the historical information is located.

While TULES alone can detect voids, reveal internal composition, and find seeps and scour – providing terabytes of data – a greater long term benefit will be in compiling this data into a GIS system with provisions for baseline standards, historical data, and new provisional layers for data from Non Destructive Test (NDT) methods as they become available for future incorporation into the TULES system.

TOOLS WE CAN USE

Terrestrial Subsurface Imaging Tool

Aquatic Subsurface Imaging Tool

Aquatic Bottom Contour Mapping

Imaging of Defect Indications

Aerial Contour Identification

Global Location Identification

COMPREHENSIVE GIS SYSTEM

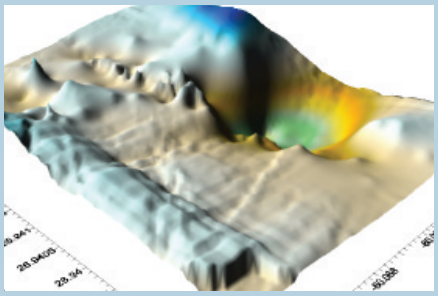
Ability for comparative analysis

Real time information

Ability to auto-flag potential problems

Multiple visualization options of asset condition

Flexibility to accommodate new technologies



PROPOSED PILOT PROJECT

DOER proposes a multi phase pilot project that would serve as a "Proof of Concept" for the Department of Water Resources. This pilot study is a very proactive and responsible approach, utilizing California small business technology to find solutions to a California crisis. Funding for the pilot study is modest as compared to the millions that stand to be squandered on expensive emergency response and what are perceived as little more than band-aid fixes by the public.

operators and resource agencies. At present, contracts have been awarded for the purpose of compiling available historical data. Others have been tasked with producing an inventory of existing levees for the purposes of asset management. These systems either need to be expanded upon or supplied as a layer to a larger master product. Alternatively, the internally produced DWR user inventory GIS system might be expanded to accept a new data layer from the TULES sensors.

requests and end use of hydrologists and environmental scientists, we maximize the return on the invested dollars past a purely engineering benefit.

Track 2: Pilot

Track 2, which can be implemented in conjunction with or ahead of Track 1, consists of selecting a test location(s) and obtaining access authorization. The sensors and application specific vehicles will be selected to undertake collection of a comprehensive data set from the pilot project site.

Although the sensors and their capabilities are known, certain on-site parameters will determine the proper frequency and configuration of sensors and antennas. Multiple sensor configurations will be evaluated during Track 2 for optimized data sets.

Presentation of the sensor to the structure is critical to stable data. During Track 2, multiple vehicles will be evaluated to see which platform is most efficient in terms of speed and data acquisition. Given the number of levees, speed of inspection will be a consideration as will the ability to move slowly over and around suspect areas where higher resolution may be critical to assessment.

Certainly, if a future State wide project is implemented, speed and efficiency will be given high priority. Track 2 testing will help DOER evaluate the maximum rate of travel while maintaining required data quality given natural variables.

Track 2 data will be fed into GIS models to test their ability to receive and classify data for real-time results while simultaneously permitting hard storage for post process study. Another goal is to test the processed data, including its ability to be incorporated into existing GIS databases or to become a framework for a master GIS product.

"Using California small business technology to find solutions to a California crisis."

Track 1: Workshop

Track 1 of the pilot program would consist of a hosted workshop to outline the type of data TULES is capable of providing and to identify the key needs and end products required by DWR and others for an inspection, classification, and dissemination system.

While DOER knows the data gathering power that TULES is capable of, convening a workshop will permit a general consensus to be formed on the best approach to a GIS system that will be usable to all of the

One goal of the workshop would be to propose or select an engineering firm to assist in developing this classification system. The classification system criteria will be critical in the development of an automated defect flagging system. Thus, when failures do occur, sites with similar characteristics will auto flag in the system, for close monitoring.

Science and environmental concerns are key players in the TULES system. The quantity and quality of data that will be collected can serve multiple purposes. If we include the

TASK 1

Workshop to:
- determine optimal GIS system
- select engineering firm to develop classification system

TASK 2

- Select test location(s)
- Fine-tune frequency and configuration of the sensors and antennas to optimize data sets
- Optimize testing platforms for speed of data acquisition
- Input into GIS models to test data processing and analysis

To: Jim Wunderman
From: Andrew Michael
RE: Bay Area response to the Delta and Levee Crisis
Date: February 24, 2006

On February 23rd, the Bay Area Council convened a meeting with the Bay Institute to begin a process to form a Bay Area response to the Delta and Levee crisis. The participants included Scientists, Hydrologists, and Engineers with extensive experience in water management and particularly in the Delta.

Issue:

The future of the Delta and the capacity for it to provide a reliable water supply, water quality, land for agricultural and urban uses is uncertain. The high level of risk of a catastrophic failure of the Levees calls for immediate action. The rare attention on the Levees following the Hurricane Katrina provides an opportunity to address a situation that is largely unseen and not thought about until after a disaster hits.

Determination of priorities for investment and the amount of funds needed in the Levee system throughout the Delta is going slowly and the data being collected is insufficient to make priorities for how the money should be best spent. Reviewing historical data about the Delta and Levees which is now occurring is not sufficient to respond to the existing and dynamic conditions in the Delta. Due to hydrologic changes in tidal action, shifting water flows, changes in climate, the Delta and its Levees are ever-changing.

There is a lack of governance and clear delineation of responsibilities among state agencies (especially the Department of Water Resources, the California Resource Agency, California Bay Delta Authority) and local governments for managing the Delta and the Levees. This lack of authority and accountability for the Delta also means there is no center for collecting and integrating the information about the Delta. Without an integrated knowledge base about the Delta and Levees, a wise determination of how to spend money to fix the most critical Levees is not possible.

Recommendations:

- Be a catalyst for using the best technology available to comprehensively gather data on the condition of the Delta and the Levee system that protect the water quality and property within the Delta. Recent developments in underground and underwater data gathering combined with the integrative power of mapping can rapidly provide the data needed to make assessments and priorities for investments in the Delta.
- Innovative companies in the Bay Area that are using the latest technology can help provide capacity to draw together the data. DOER for instance has specialized in deepwater ocean research and can adapt their reconnaissance technology to fully map Levees using surface vehicles, underground censors, laser

technology that defines the soil composition of the Levees, the hydrologic forces impacting the Levees and even real-time censors to assess how to repair Levees.

- An immediate privately funding pilot application of this technology on a portion of the Delta Levees (or maybe even the South Bay Levees) could demonstrate the power and need to use this technology to make the best economic decisions about how to manage the Delta and the Levees.

Next Step:

1. Develop a strategy to finance the pilot demonstration of technology, estimated cost of $250,000 to $500,000.
2. Inform the State Agencies responsible for Delta Levee Risk Assessment of the comprehensive information system available to do the assessment, seek their involvement in the Pilot
3. Advocate with other Stakeholders from around the State on the need for the application of this scientific approach to prioritizing investment in the Delta and Levees system.

Key Participants in the meeting:

Grant Davis, Executive Director, Bay Institute
Liz Taylor, President, DOER Subsea Robotics & Submersible Systems (Alameda) (daughter of Dr. Sylvia Earle, Founder of DOER and close friend of Senator Diane Feinstein)
Ian Griffith, DOER
Owen Lang, ASLA, Principal, Sasaki Associates, Inc.
Bob Erickson, Chair, Bay Institute
Dr. Phil Williams, Founder, Phil Williams Associates (Hydrology)
Cinthia Murray, Chair, Bay Area Water Forum developing the Integrated Regional Water Management Plan for the Bay Area
Tina Swanson, Scientist, Bay Institute (working with Dr. Jeffrey Mount, UC Davis)
Jamie Kuskos, San Francisco Estuarian Research working with NOAH, BCDC, State Parks)
Mark Holmes, Member of Cal Fed Bay Delta Authority